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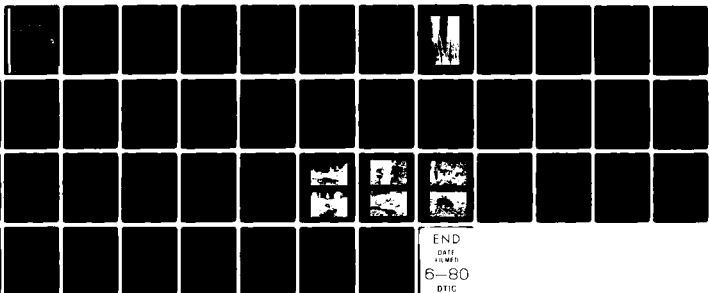
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JAMES RIVER BASIN

Name of Dam: Grahams Dam

Location: Albemarle County, State of Virginia

Inventory Number: VA 00342

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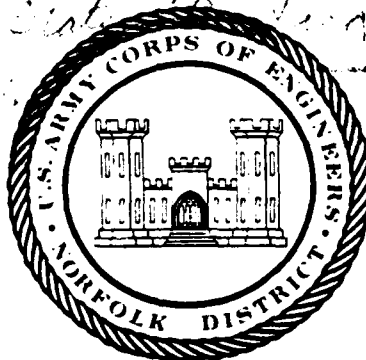
PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Graham's Dam (VA-00342). James River Basin.
Albemarle County, State of Virginia.

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Phase I Inspection
Report



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Final

PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: GRAHAMS DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Grahams Dam
State: Virginia
County: Albemarle
USGS 7.5 Minute Quadrangle: Charlottesville East, VA
Stream: Unnamed Tributary to Camp Branch
Date of Inspection: 12 November 1979

BRIEF ASSESSMENT OF DAM

Grahams Dam is an earth dam approximately 165 feet long and 29 feet high with two vegetated earth emergency spillways, one 50 feet wide in the left abutment and one 30 feet wide in the right abutment. The dam, located approximately 4.6 miles east of Charlottesville, Virginia and 0.4 mile northeast of Shadwell, Virginia, is used for livestock water supply and limited recreation by the owner, Mr. Ray A. Graham, Jr. Grahams Dam is a "small" size - "significant" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams. Visual inspection and office analyses indicate no deficiencies requiring emergency attention.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the spillway design flood (SDF). The SDF was routed through the reservoir and found to overtop the dam by a maximum depth of 0.15 foot with an average critical velocity of 1.8 f.p.s. Total duration of dam overtopping would be approximately 0.6 hour. The spillways are capable of passing only 90 percent of the 100-year flood or 18 percent of the Probable Maximum Flood (PMF) and are therefore adjudged as inadequate, but not seriously inadequate.

It is recommended that the erosion and migration of the left emergency spillway channel be repaired to protect the stability of the embankment. The principal spillway intake should be cleaned and an improved trash rack installed. The channel immediately downstream of the principal spillway outlet should be cleared of the rock eroded from the left emergency spillway. The emergency drawdown outlet gate valve should be cleaned and lubricated. The downstream embankment face should be cleared of all trees and brush. Areas where erosion has begun should be regraded and reseeded as necessary. Riprap should be placed on the upstream embankment near the waterline. The seepage near the toe of the dam should be examined regularly. If turbidity or changes in the rate of flow develop, the services of a qualified geotechnical

NAME OF DAM: GRAHAMS DAM

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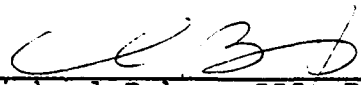
engineering firm should be immediately retained for further evaluation. An emergency action plan and warning system should be developed. A staff gage should be installed.

MICHAEL BAKER, JR., INC. SUBMITTED:

Original Signed by
JAMES A. WALSH

James A. Walsh, P.E.
Chief, Design Branch

Original Signed by:
Ronald G. Vann


Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer

RECOMMENDED:

for

Jack G. Starr, P.E.
Chief, Engineering

Original signed by:
Douglas L. Haller

APPROVED:

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer



Date:

MAR 14 1980

NAME OF DAM: GRAHAMS DAM



OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: GRAHAMS DAM ID# VA 00342

SECTION 1 - PROJECT INFORMATION

1.1 General

- 1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.
- 1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guideline for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

- 1.2.1 Description of Dam and Appurtenances: Grahams Dam (also known as Grahams Pond) is an earthfill embankment approximately 29 feet high¹ and 165 feet long. The upstream and downstream embankment slopes are approximately 4H:1V (Horizontal to Vertical) and 3H:1V respectively. The crest of the dam is approximately 15 feet wide and has a minimum elevation² of 382.0 feet Mean Sea Level (M.S.L.) at a point adjacent to the left³ spillway.

The dam has two trapezoidal shaped vegetated earth spillways, one adjacent to each abutment. The left spillway has a bottom width of 50 feet with a minimum elevation at the control section of 379.0 feet M.S.L. The

¹Measured from the emergency drawdown conduit invert at the downstream toe to the embankment crest.

²All elevations are referenced to the elevation of the normal pool on the upstream dam as indicated on the Charlottesville East, Virginia 7.5 minute USGS quadrangle.

³Facing downstream.

right spillway has a bottom width of 30 feet and a minimum elevation at the control section of 381.1 feet M.S.L.

The principal spillway is a 12 inch corrugated metal pipe projecting through the embankment at approximately a 19 percent slope and exiting at the toe near the center of the dam. Drawdown facilities at the dam consist of a 6 inch cast-iron emergency drawdown conduit with a gate valve at its downstream end.

- 1.2.2 Location: Grahams Dam is located on a small tributary to Camp Branch approximately 1.2 miles upstream from the Rivanna River in Albemarle County, Virginia. The dam is situated approximately 4.6 miles east of Charlottesville, Virginia and 0.4 mile northeast of Shadwell, Virginia. Access to the dam is obtained from State Route 22 east of Shadwell, Virginia. A Location Plan is included in this report.
- 1.2.3 Size Classification: The maximum height of the dam is 29 feet and the reservoir storage capacity to the crest of the dam, elevation 382.0 feet M.S.L., is 30 acre-feet. Therefore the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.
- 1.2.4 Hazard Classification: Immediately downstream of Grahams Dam is State Route 22. Route 22 is built on a fairly high embankment in this area and would significantly reduce the size of the flood wave as it passed downstream. But Route 22 itself could suffer extensive damage in the event of a dam failure by overtopping. For this reason, Grahams Dam is classified in the "significant" hazard category according to the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.

- 1.2.5 Ownership: The dam is owned by Mr. Ray A. Graham, Jr. of Shadwell, Virginia.
- 1.2.6 Purpose of Dam: The reservoir impounded by the dam is used for livestock water supply and limited recreation.
- 1.2.7 Design and Construction History: No design records are available; however, the dam was generally sized and constructed with the assistance of the local U.S. Soil Conservation Service (SCS) office. The earthmoving activities were conducted in 1957 by Moore, Kelly and Reddish, of Orange, Virginia. This company is still in operation in a descendent firm, Moore Golf, Inc., Culpepper, Virginia.
- 1.2.8 Normal Operational Procedures: The reservoir is normally operated at the level of the principal spillway invert, elevation 377.9 feet M.S.L. No formal operating procedures are followed for this structure. See paragraph 4.1 for detailed operating procedures.

1.3 Pertinent Data

- 1.3.1 Drainage Area: The drainage area tributary to the dam is 0.94 square mile.
- 1.3.2 Discharge at Dam Site: The maximum discharge from the reservoir is unknown.

Principal Spillway:

Pool level at top of dam 7 c.f.s.

Emergency Spillways:

Pool level at top of dam 1161 c.f.s.

- 1.3.2 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet M.S.L.	Area acres	Reservoir Capacity		Length feet
			Acre- feet	Watershed inches	
Top of dam	382.0	4.4	30	0.6	805
Right emergency spillway invert	381.1	4.0	27	0.5	800
Left emergency spillway invert	379.0	3.2	19	0.4	795
Principal spillway invert (normal pool)	377.9	2.8	16	0.3	790
Streambed at downstream toe of dam	354.2	-	-	-	-

NAME OF DAM: GRAHAMS DAM

SECTION 2 - ENGINEERING DATA

- 2.1 Design: There were no design reports available for preparation of this report.
- 2.2 Construction: There were no pre-construction studies or as-built plans available for review.
- 2.3 Evaluation: No design drawings were completed for this dam, nor were construction records available for review. Evaluations made in this report are based primarily on field observations, measurements taken during the inspection, and interviews with the owner. No assessment of the engineering was possible due to the lack of adequate design data.

NAME OF DAM: GRAHAMS DAM

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The field inspection was conducted on 12 November 1979. Skies were overcast and a slight drizzle persisted throughout the day. Ground conditions were damp due to the drizzle and previous days of rain. The recorded temperature was 40°F. At the time of the inspection, the pool elevation was 379.0 feet M.S.L. and the tailwater elevation was 355.2 feet M.S.L.; a small flow (approximately 1 c.f.s.) was passing through the left emergency spillway. No record was found of any previous inspections. The embankment and appurtenant structures were found to be in fair to poor condition at the time of inspection. The following are brief summaries of deficiencies found during the inspection. A Field Sketch of conditions is shown as Plate 1. The complete visual inspection check list may be found in Appendix III.

3.1.2 Dam: The embankment shows no surface cracks; however, there is a large area of dormant, yellow vegetation associated with damper ground in the center of the downstream face. Slightly above and to the right of this area are horizontal lines of small sloughing also associated with this wet ground. Scattered brush and small trees are growing on the downstream face of the embankment. Near the crest and to the left on the embankment and extending through the junction to the left abutment exists an area of sparse vegetation. The bare ground in this area shows signs of erosion and run-off into the eroded left emergency spillway channel. Points of noticeable seepage were concentrated at the toe near the principal spillway outlet and drawdown conduit outlet. Estimated flow at each point was less than one gallon per minute. The right abutment has been affected by run-off from the adjacent hillside; a significant gully, 20 feet to the right of the abutment's junction with the embankment, has been eroded (see Photo 3). The left abutment's junction with the adjacent emergency spillway has been severely eroded by the spillway channel's migration. The upstream embankment shows signs of beginning erosion at the waterline.

NAME OF DAM: GRAHAMS DAM

3.1.3 Appurtenant Structures: The approach and discharge channels of the left emergency spillway are severely eroded to the underlying bedrock. The discharge channel has migrated towards the left abutment (see Photo 2). The principal spillway is a 12 inch corrugated metal pipe which was partially clogged with weeds at the time of inspection. An improved trashrack is necessary. The emergency drawdown outlet, located to the right of the principal spillway outlet, was leaking and should be cleaned and lubricated (see Photo 4). There was an additional 12 inch corrugated metal pipe present to the left of the principal spillway outlet; however, the origin of the pipe could not be determined. The owner was asked about this pipe, but had no knowledge of its purpose or the location of its upper end. There was a small flow (less than 1 gallon per minute) passing through this pipe.

3.1.4 Reservoir Area: The surrounding slopes are gradual and well vegetated. The west slopes show signs of beginning erosion gullies. There are three smaller dams upstream of Grahams Dam. The largest of these is located at the upstream end of the pool formed by Grahams Dam; it is 20 feet high and has a maximum storage capacity of approximately 20 acre-feet. The extent of sedimentation was not observed in Grahams Dam reservoir, but would be expected to be minimal because of the upstream dams.

3.1.5 Downstream Channel: The downstream channel is clear and the slopes show no signs of erosion. Vegetation on the overbanks consists of trees and thin brush. Route 22 crosses the stream approximately 300 feet downstream. The crossing consists of a 6 foot by 6 foot box culvert with wingwalls at 30° and 45°. The road is on an embankment with the road surface approximately 10 feet above the culvert.

3.2 Evaluation: Although the seepage does not appear to seriously affect the stability of the dam at this time, it should be regularly inspected for turbidity and/or increase in flow which would indicate the potential for piping of embankment material. The damp ground on the downstream embankment indicated by dormant vegetation

should also be monitored. The associated sloughing areas, as well as the bare areas near the abutments, should be graded and reseeded. All of the trees and heavy brush should be removed from the face; roots can be left in place. Filling and grading of the gully on the right abutment is also necessary. The more serious problem of the left emergency spillway condition may be improved by filling and grading the present channel and by extending the left abutment to form a more defined channel located farther from the dam itself. Riprap should be placed near the waterline on the upstream embankment to prevent further erosion from wave action.

NAME OF DAM: GRAHAMS DAM

SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: Operation of the dam is an automatic function maintained by the principal spillway and the emergency spillways. Water entering the reservoir flows into the principal spillway at elevation 377.9 feet M.S.L. When the inflow is sufficient the reservoir level rises above elevation 379.0 feet M.S.L. and discharges through the left emergency spillway. The right spillway will begin to discharge at elevation 380.1 feet M.S.L. Additionally, according to the owner, his groundskeeper normally opens the valve on the emergency drawdown conduit of this dam when a large rainfall is expected.
- 4.2 Maintenance of Dam: Maintenance of the dam is the responsibility of the owner. The owner's groundskeepers perform general maintenance, limited to small items such as debris cleaning, periodically, in addition to other maintenance on the grounds. A regular inspection and maintenance schedule with a log has not been instituted.
- 4.3 Maintenance of Operating Facilities: The only control equipment at the dam is the gate valve on the emergency drawdown conduit at the base of the dam. This valve is currently leaking; however, it is operable. The valve is in need of lubrication and repair.
- 4.4 Warning System: At the present time, there is no formal warning system in operation.
- 4.5 Evaluation: Maintenance of the dam in the past has been very limited and must be improved to include immediate spillway and miscellaneous repairs, post-storm maintenance, and regularly scheduled maintenance. Additionally, an annual inspection of the dam should be performed. It is also recommended that a formal warning system and emergency action plan be developed and put into effect.

NAME OF DAM: GRAHAMS DAM

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: No design data were available for use in preparing this report.
- 5.2 Hydrologic Records: No rainfall, stream gage, or reservoir stage records are maintained for this dam.
- 5.3 Flood Experience: No records were available. According to the owner, the last major flood was caused by rainfall from the remnants of Hurricane David in September 1979. It was during this flood that most of the erosion in the left emergency spillway occurred. The flood left a high water mark at elevation 381.4 feet, M.S.L.; 2.4 feet above the invert of the emergency spillway.
- 5.4 Flood Potential: The Probable Maximum Flood (PMF), 1/2 Probable Maximum Flood (1/2 PMF), and the 100-year flood were developed and routed through the reservoir by use of the HEC-1 DB computer program (Reference 9, Appendix IV) and appropriate unit hydrograph, precipitation, and storage-outflow data. Clark's T_C and R coefficients for the local drainage areas were estimated from basin characteristics. The rainfall applied to the unit hydrograph was taken from publications by the U.S. Weather Bureau and the National Oceanic and Atmospheric Administration (References 16 and 17, Appendix IV). Rainfall losses for the 100-year flood were estimated at an initial loss of 1.5 inches and a constant loss thereafter of 0.15 inch per hour. An initial loss of 1.0 inch and a loss rate of 0.05 inch per hour were used for the PMF and 1/2 PMF.
- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, Paragraph 1.3.3.

Regulation of flow from Grahams Dam is automatic. The normal pool, elevation 377.9 feet M.S.L., is maintained by the upstream invert of the principal spillway. Excess flood flows are discharged through the left emergency spillway when the reservoir rises to levels above 379.0 feet M.S.L. Flow through the right emergency spillway begins when reservoir levels rise above 380.1 feet M.S.L. All water discharged from the reservoir flows into Camp Branch.

Outlet discharge capacity was computed by hand; reservoir area was planimetered from the Charlottesville East, Virginia, 7.5 minute USGS quadrangle; and storage capacity was computed by the HEC-1 program. All flood routings were begun with the reservoir at normal pool.

NAME OF DAM: GRAHAMS DAM

5.6 Overtopping Potential: The probable rise in reservoir and other pertinent information on reservoir performance for the 100-year flood, 1/2 PMF, and PMF hydrographs are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal(a)	Hydrographs		
		100-year flood(b)	1/2 PMF	PMF(c)
Peak flow, c.f.s.				
Inflow	7.6	1289	3267	6548
Outflow	7.6	1276	3266	6547
Peak elev., ft. M.S.L.	379.0	382.15	383.84	385.15
Left emergency spillway(d) (elev. 379.0 ft. M.S.L.)				
Depth of flow, ft.	-	3.15	4.84	6.15
Average velocity, f.p.s.	-	8.2	10.2	11.5
Duration of overtopping, hrs.	-	15.0	23.1	27.9
Right emergency spillway(d) (elev. 380.1 ft. M.S.L.)				
Depth of flow, ft.	-	2.05	3.74	5.05
Average velocity, f.p.s.	-	6.6	9.0	10.4
Duration of overtopping, hrs.	-	4.3	12.7	17.8
Non-overflow section (elev. 382.0 ft. M.S.L.)				
Depth of flow, ft.	-	0.15	1.84	3.15
Average velocity, f.p.s.	-	1.8	6.3	8.2
Total duration of over- topping, hrs.	-	0.6	2.8	4.5
Tailwater elev., ft. M.S.L.	355.2	-	-	-

(a) Conditions at time of inspection.

(b) The 100-year flood is an estimate of flood discharges that will occur, on the average, once in a 100-year period. It may occur in any given year.

(c) The PMF is an estimate of flood discharges that may be expected from the most severe combinations of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

(d) Depth and velocity estimates were based on critical depth at the control section.

NAME OF DAM: GRAHAMS DAM

- 5.7 Reservoir Emptying Potential: The reservoir can be drawn down by means of the gated 6 inch cast-iron emergency drawdown conduit. Neglecting inflow, the reservoir can be drawn down from normal pool in approximately 20 days. This is equivalent to an approximate drawdown rate of 1.25 feet per day based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.
- 5.8 Evaluation: Grahams Dam is a "small" size - "significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range between the 100-year flood and the 1/2 PMF. The magnitude that most closely relates to the risk involved (in the event of overtopping) should be selected. For Grahams Dam, the 100-year flood was selected as the SDF, based on the small size of the dam. The 100-year flood was routed through the reservoir and found to overtop the dam with a maximum depth of 0.15 foot with an average critical velocity of 1.8 f.p.s. Total duration of dam overtopping would be 0.6 hour. The spillways are capable of passing approximately 90 percent of the 100-year flood, which is approximately 18 percent of the PMF.

Conclusions pertain to present day conditions and the effect of future development on the hydrology has not been considered.

SECTION 6 - DAM STABILITY

6.1 Foundations and Abutments: There is no information available on the foundation conditions. The dam is in the Piedmont physiographic province of Virginia. It is unknown if the dam is keyed into the foundation or whether or not there is a drainage system. During the field inspection, a 12 inch corrugated metal pipe was found to the left of the principal spillway outlet; however, the origin and purpose of this pipe could not be determined. As noted in the visual inspection, there were areas of seepage near the toe of the embankment.

6.2 Embankment

6.2.1 Materials: There is no information available on the nature of the embankment materials. The area soils are low-plastic silts and clays.

6.2.2 Stability: There are no available stability calculations. The dam is 29 feet high and 15 feet wide. It has an estimated upstream slope of 4H:1V and a measured downstream slope of 3H:1V. The dam exists at normal storage pool. It is not known whether or not the dam was ever subjected to a maximum storage pool. The dam has a freeboard of approximately 1 foot from maximum control storage. It is subjected to a sudden draw-down because the approximate drawdown rate of 1.25 feet per day exceeds the critical rate of 0.5 foot per day for earth dams.

According to guidelines presented in Design of Small Dams by the U.S. Department of the Interior, Bureau of Reclamation, for small homogeneous dams, with a stable foundation, subjected to a drawdown, and composed of low-plastic fines (CL, ML); the recommended slopes are 3H:1V upstream and 2.5H:1V downstream. The recommended width is 16 feet. Based on these guidelines, the dam has adequate slopes and an adequate width.

6.2.3 Seismic Stability: The dam is located in Seismic Zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no

NAME OF DAM: GRAHAMS DAM

hazard from earthquakes provided static stability conditions are satisfactory and conventional safety margins exist.

- 6.3 Evaluation: There is insufficient information to adequately evaluate the stability of the dam. However, the visual inspection revealed no apparent instability. Also, based on the Bureau of Reclamation guidelines, the dam width and slopes are adequate. Based on these conditions, the embankment is considered stable for normal pool conditions. The dam is considered stable for maximum control storage due to its low freeboard.

Also, despite the inability of the spillways to pass the design flood, the depth, duration, and rate of overtopping flows are not considered detrimental to the embankment. Overtopping flows are shallow, last 0.6 hour, and the velocity is less than 6 f.p.s., the effective eroding velocity for a vegetated earth embankment.

During the inspection, small seeps were observed near the toe of the embankment. It is recommended that the seepage areas be visually inspected during all periods of high reservoir levels to determine any turbidity and/or any increase in the rate of seepage. If turbidity or changes of rate develop, the services of a qualified geotechnical engineering firm should be immediately retained for further evaluation.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

- 7.1 Dam Assessment: Deficiencies were discovered during the field inspection and office analyses of Grahams Dam which will necessitate further attention. No boring records, construction reports, or stability analyses were available for use in assessing the stability of the dam.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the SDF for the "small" size - "significant" hazard classification of Grahams Dam. The spillways are capable of passing only 90 percent of the SDF or 18 percent of the PMF. The spillways are therefore adjudged as inadequate, but not seriously inadequate.

Severe erosion has taken place in the left emergency spillway; the spillway has eroded out of its original channel and has migrated until it is beginning to encroach upon the left side of the embankment. Rock eroded from the emergency spillway has partially blocked the principal spillway outlet. The intake of the principal spillway is partially blocked by weeds. The gate on the emergency drawdown conduit is leaking and there are several small areas of seepage near the toe of the dam. Erosion is beginning or has begun in several small areas. The downstream embankment has several areas covered by small trees and brush.

- 7.2 Recommended Remedial Measures: The erosion and migration of the left emergency spillway should be repaired before it threatens the stability of the embankment.

The principal spillway intake should be cleaned and an improved trash rack installed; the channel immediately downstream of the principal spillway outlet should be cleared of the rock which has eroded from the left emergency spillway. The gate valve on the emergency drawdown conduit should be cleaned and lubricated.

The seepage areas should be visually inspected during all periods of high reservoir levels to determine any turbidity and/or increase in the rate of seepage. If turbidity or changes of rate develop, the services of a qualified geotechnical engineering firm should immediately be retained for further evaluation.

All trees and brush on the embankment should be removed; roots can be left in place. The embankment should be

NAME OF DAM: GRAHAMS DAM

cut regularly. Areas where embankment erosion is beginning or has already begun should be regraded and reseeded as necessary. Riprap should be placed near the waterline on the upstream embankment to prevent further erosion from wave action.

The owner should develop an emergency action plan outlining actions to be taken to minimize downstream effects of an emergency, and develop and implement an effective warning system. A staff gage should be installed to monitor high water levels in the reservoir. A formal inspection and maintenance program should also be developed.

NAME OF DAM: GRAHAMS DAM

APPENDIX I

PLATES

CONTENTS

Location Plan

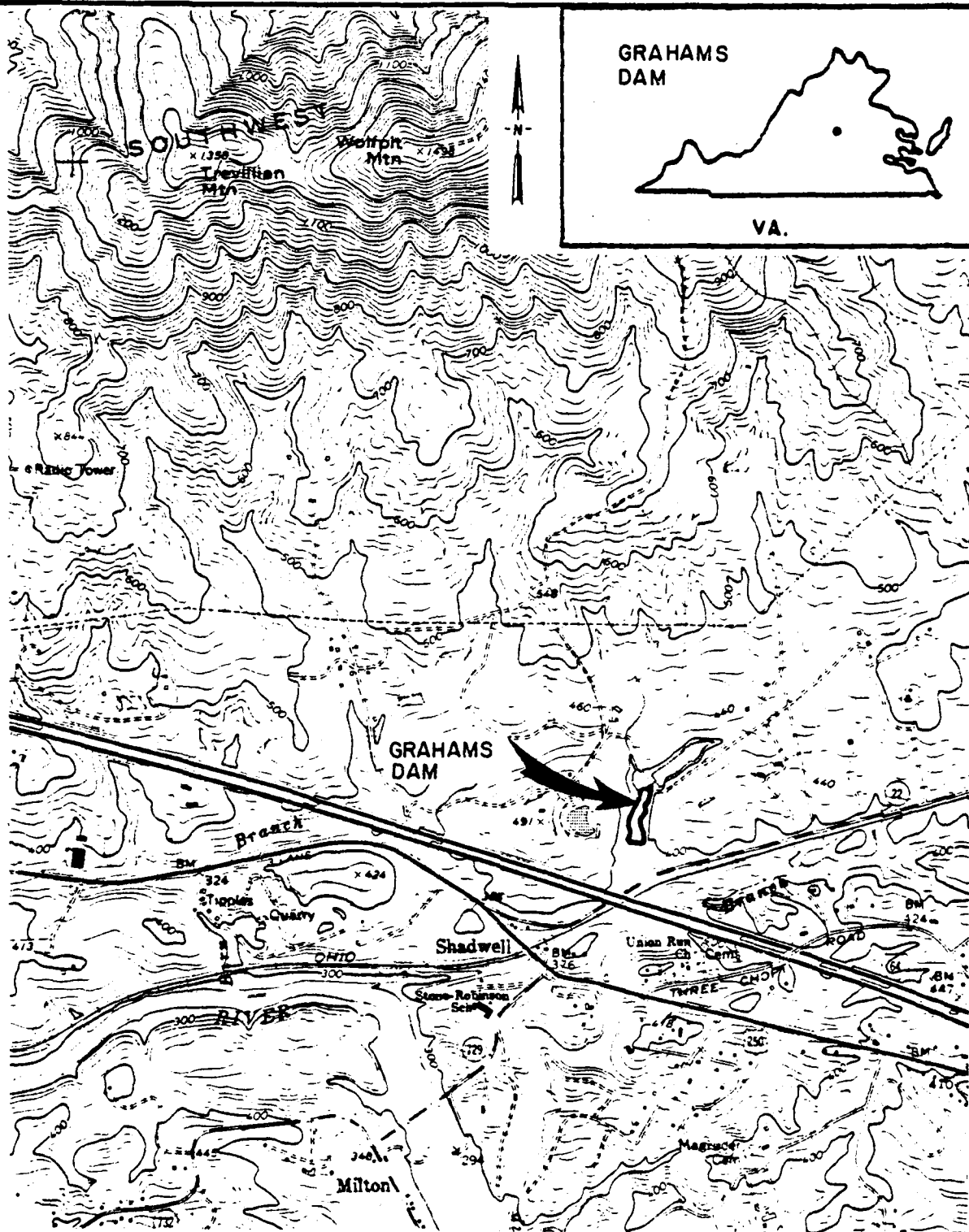
Plate 1: Field Sketch

Plate 2: Plan of Water Impounding Structure

Plate 3: Typical Cross Section

Plate 4: Top of Dam Profile

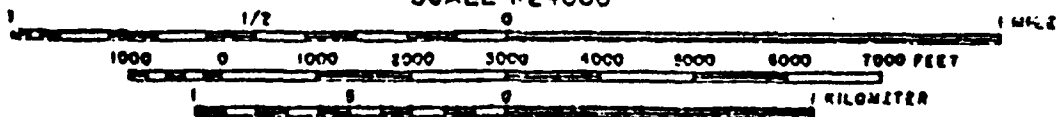
NAME OF DAM: GRAHAMS DAM



GRAHAMS
DAM

VA.

SCALE 1:24000

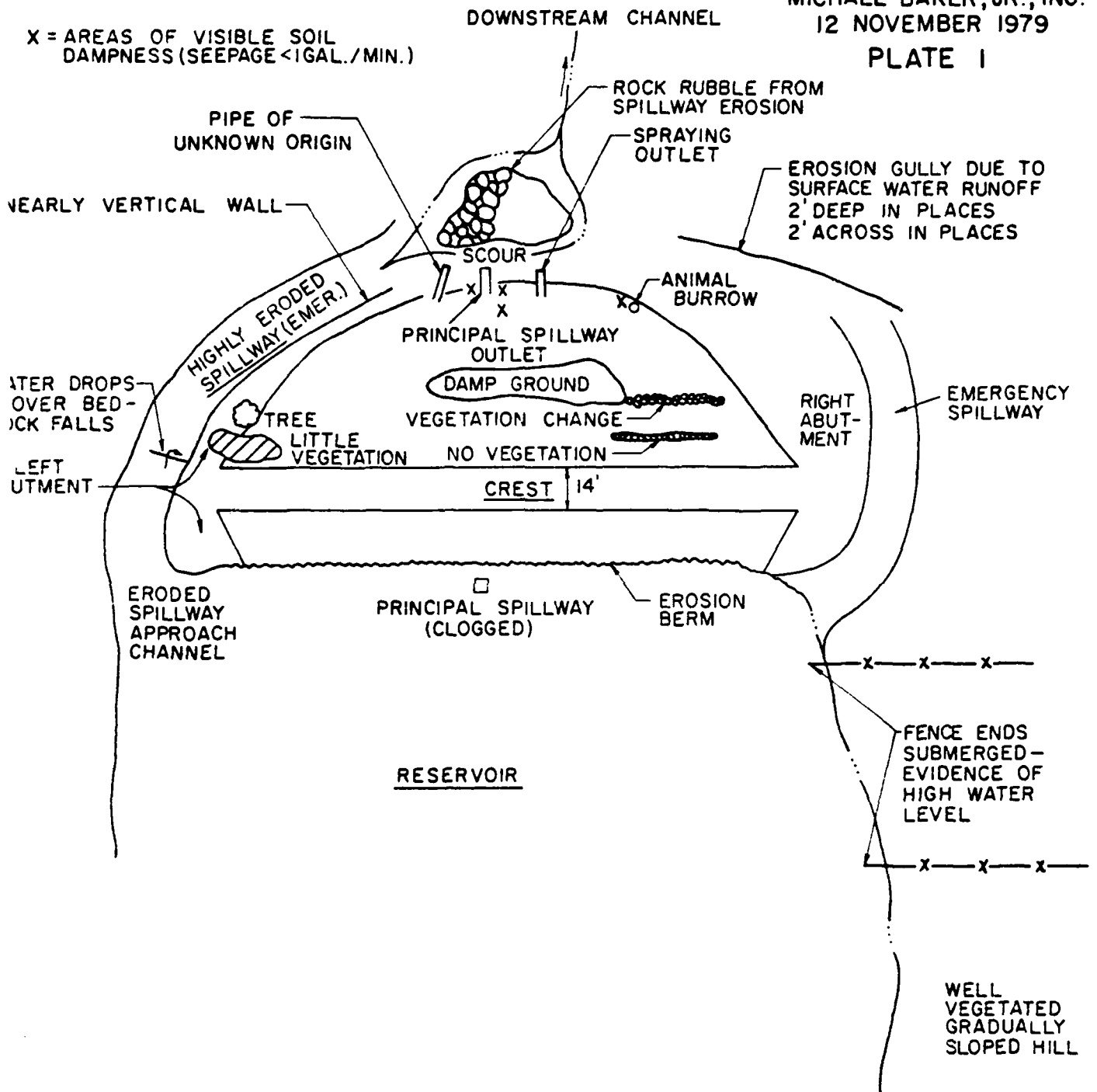


GRAHAMS DAM
LOCATION PLAN

FIELD SKETCH

GRAHAM'S DAM
MICHAEL BAKER, JR., INC.
12 NOVEMBER 1979

PLATE I



NOTE:

DOWNSTREAM EMBANKMENT SOMEWHAT IRREGULAR / SLIGHTLY GULLIED
BEDROCK OF SPILLWAY HIGHLY FRACTURED
STRIKE - 60° E DIP - 68°
WATER FLOWING THROUGH LEFT EMERGENCY SPILLWAY AT TIME OF INSPECTION

NO SCALE

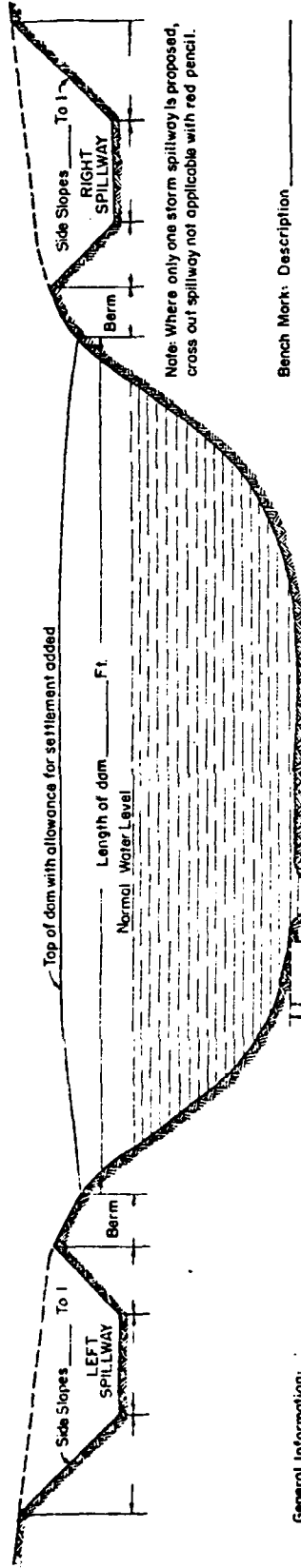
Farm Operator _____ Type _____
W. U. Farm Plan No. _____
S. C. S. Photograph No. _____

PLAN OF WATER IMPOUNDING STRUCTURE

(FARMER'S COPY)
PLATE 2

SOIL CONSERVATION SERVICE

State _____
County _____
Date _____



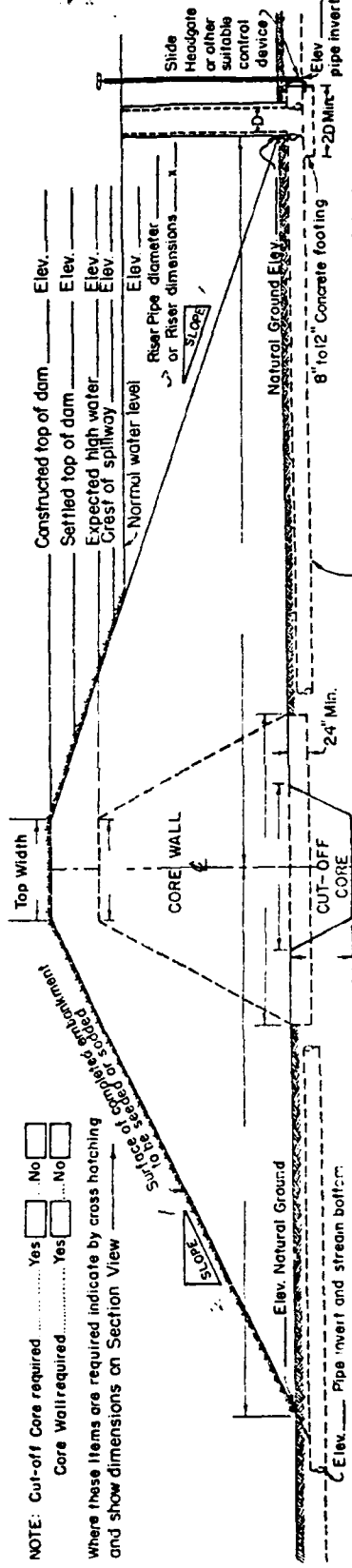
PROFILE VIEW LOOKING DOWNSTREAM

General Information:
Proposed use for water impounded _____
Size of contributing watershed _____ acres
Quantity of materials in the embankment including allowance for settlement _____ cu. yds.

Bench Mark: Description _____
Elev. _____

SEEPAGE COLLARS
FOR DRAIN PIPE

No. Required _____
Specify Kind _____



SECTION THROUGH DAM AT POINT OF MAXIMUM HEIGHT

Note: Trench for drain pipe must be excavated into stable material.

GRAHAM'S DAM
TYPICAL CROSS SECTION
SCALE: AS SHOWN

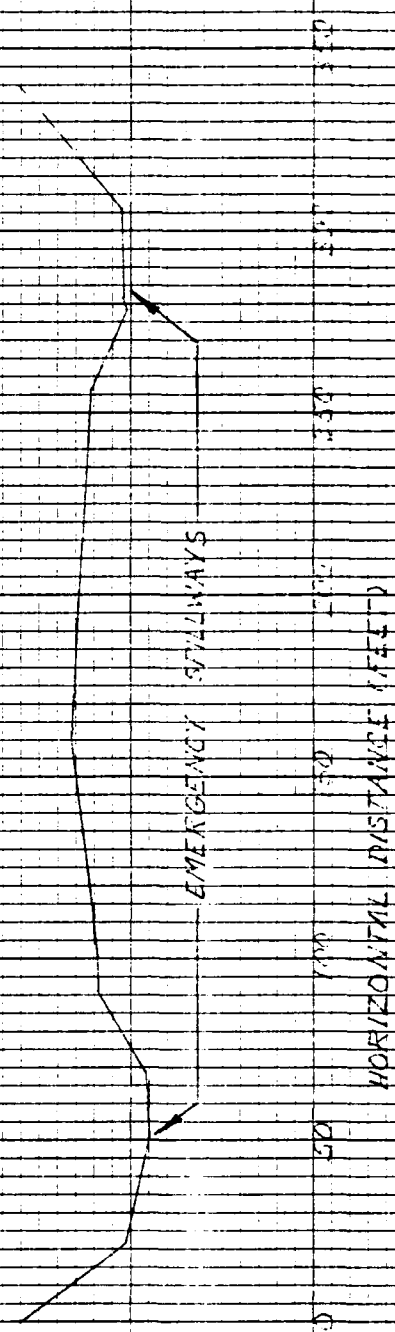


PLATE 5
MICHAEL BAKER, TR., INC.

GRAHAM'S DAM
 TOP OF DAM PROFILE
 SCALE: AS SHOWN
 VIEW: FACING DOWNSTREAM

ELEVATION (FEET ABOVE M.S.L.)

470
 460
 450



HORIZONTAL DISTANCE (FEET)

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 720 740 760 780 800 820 840 860 880 900 920 940 960 980 1000

PLATE 4
 RICHARD E. GIBSON, INC.

APPENDIX II

PHOTOGRAPHS

CONTENTS

- Photo 1: Downstream Embankment and Severe Erosion in Left Emergency Spillway
- Photo 2: Looking Upstream at Erosion in Left Emergency Spillway
- Photo 3: Erosion Gully Twenty Feet Right of Junction Between Downstream Embankment and Right Abutment
- Photo 4: Principal Outlet (Marked by Rod) and Emergency Draw-down Outlet
- Photo 5: Unidentified Pipe Fifteen Feet Left of Principal Outlet
- Photo 6: Looking Downstream from Outlets

Note: Photographs were taken on 12 November 1979.

NAME OF DAM: GRAHAMS DAM

GRAHAMS DAM

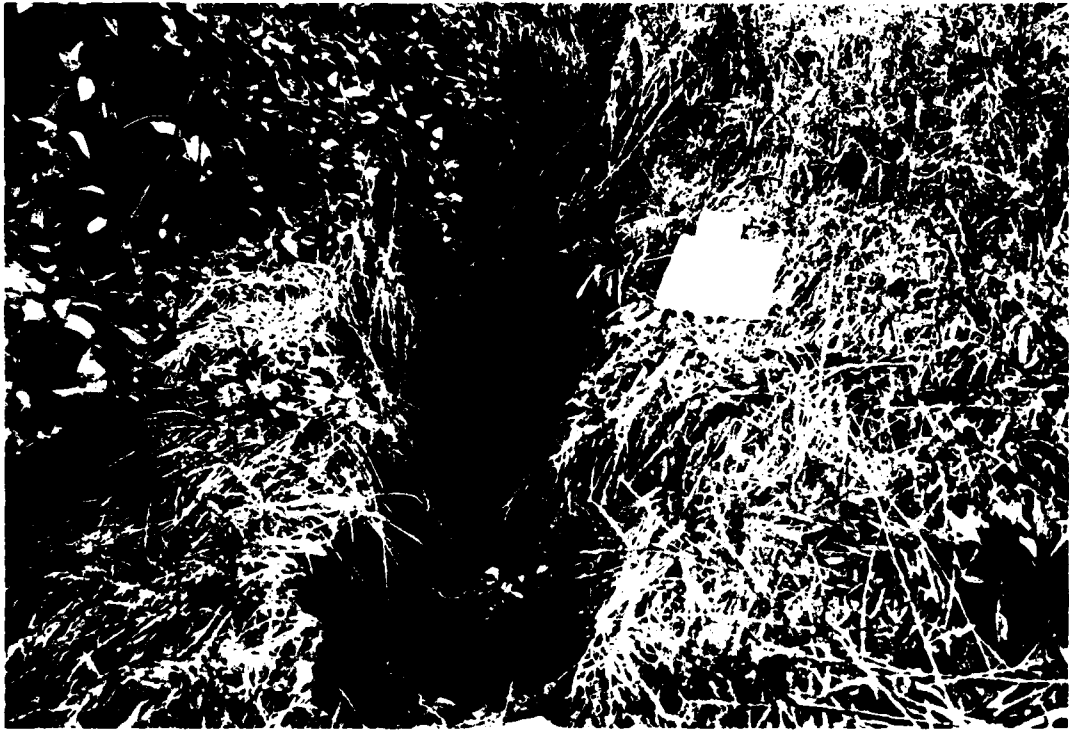


**PHOTO 1. Downstream Embankment and Severe Erosion
in Left Emergency Spillway**



PHOTO 2. Looking Upstream at Erosion in Left Emergency Spillway

GRAHAMS DAM



**PHOTO 3. Erosion Gully Twenty Feet Right of Junction Between
Downstream Embankment and Right Abutment**



**PHOTO 4. Principal Outlet (Marked by Rod) and
Emergency Drawdown Outlet**

GRAHAMS DAM



PHOTO 5. Unidentified Pipe Fifteen Feet Left of Principal Outlet



PHOTO 6. Looking Downstream from Outlets

APPENDIX III

VISUAL INSPECTION CHECK LIST

Check List
Visual Inspection
Phase 1

Name of Dam Grahams Dam County Albemarle State Virginia Coordinates Lat. N3801.7
Long. W7839.1

Date of Inspection 12 November 1979 Weather Rainy/Overcast Temperature 40°F.

Pool Elevation at Time of Inspection 379.0 ft. M.S.L. Tailwater at Time of Inspection 355.2 ft. M.S.L.

1111-1

Inspection Personnel:

Michael Baker, Jr., Inc.:

David J. Greenwood, P.E.
Jeffrey A. Quay
Leslie K. Black

Virginia Water Control Board:

Leon Musselwhite
David Bushman

Owner's Representatives:

Mr. Ray A. Graham, Jr., the
owner, did not accompany the
inspection team during the
inspection but did speak with
them after the inspection.

Leslie K. Black Recorder

EMBANKMENT

Name of Dam: GRAHAMS DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	There were no cracks observed; however, there was a large area of dormant, yellow vegetation associated with damp ground in the center of the downstream embankment. There is an area of sparse vegetation near the crest of the dam on the left side and on the left abutment. Erosion is taking place in this area.	Areas of sparse vegetation should be reseeded.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	There was no apparent movement or cracking except where the left emergency spillway encroaches on the toe. In this area, severe erosion has occurred. The left emergency spillway has eroded to bedrock and migrated out of its original channel.	Consideration should be given to the possibility of regrading and realigning the left emergency spillway.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	There is severe erosion on both downstream abutments from natural run-off. The erosion areas are approximately 20 ft. downstream of the junctions of the embankment and abutments. The upstream embankment shows signs of beginning erosion at the waterline. There is an area of sloughing in the upper right portion of the downstream embankment.	The areas of severe erosion should be filled and reseeded. If erosion reoccurs, riprap should be considered. Riprap should be placed on the upstream face near the waterline.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The crest is highest at the center of the dam. There are emergency spillways beside both abutments. The horizontal alignment is fairly even.	

EMBANKMENT

Name of Dam: GRAHAM'S DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RIPRAP	There is no riprap present.	Riprap should be installed on the upstream face of the embankment near the waterline and in the control sections and discharge channels of the emergency spillways.

EMBANKMENT

Name of Dam: GRAHAMS DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	The upstream embankment has a good cover of grass. The downstream embankment is covered with high grass, scattered brush, and small trees.	The brush and trees should be removed; the grass on the embankment should be cut regularly.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	There is severe erosion at the junction of the left emergency spillway and the dam. The spillway has eroded through several feet of weathered red shale and migrated out of its original channel.	The spillway appears to have stabilized in its present location. However, a further investigation should be carried out by a qualified geotechnical professional to determine if this erosion threatens the stability of the dam.
ANY NOTICEABLE SEEPAGE	There are small seeps at several points along the toe near the principal spillway and emergency drawdown outlets. The total flow is estimated at less than one g.p.m.	The seeps should be monitored regularly and during periods of high reservoir levels for turbidity and/or increase in flow which may indicate a potential for piping of embankment materials.
STAFF GAGE AND RECORDER	None	A staff gage should be installed.
DRAINS	One drain, a 12 in. C.M.P., was uncovered during the inspection. This pipe was passing a discharge estimated at less than one g.p.m. The origin of the pipe was not determined.	The pipe goes into the embankment, but the upstream end of the pipe could not be located during the inspection. The owner had no knowledge of the pipes purpose.

OUTLET WORKS

Name of Dam: GRAHAMS DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not Applicable	
INTAKE STRUCTURE	The intake structure is a 12 in. C.M.P. with an improvised trash rack. The intake was partially blocked with weeds at the time of the inspection.	The intake structure should be cleaned out and an improved trash rack should be installed.
OUTLET STRUCTURE	The outlet structure is a 12 in. C.M.P. The outlet was almost completely submerged at the time of the inspection.	
OUTLET CHANNEL	The outlet channel immediately downstream of the outlet is ill-defined and partially blocked with rock that has eroded from the left emergency spillway. Farther downstream, the channel is fairly clear.	The rock eroded from the left emergency spillway should be cleaned from the outlet channel and the channel alignment improved.
EMERGENCY GATE	The emergency drawdown conduit is a 6 in. C.I.P. with a gate valve at the downstream end. The gate valve was leaking at the time of the inspection.	The gate valve should be cleaned and lubricated.

UNGATED SPILLWAY

Name of Dam: GRAHAMS DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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CONCRETE WEIR

Not Applicable

APPROACH CHANNEL

There is significant erosion in the approach channel of the spillway in the left abutment. This spillway is no longer well-defined. The spillway in the right abutment is well-defined and well vegetated, with no signs of erosion.

Riprap should be placed in the approach channel of the spillway in the left abutment.

DISCHARGE CHANNEL

The discharge channel of the left spillway is eroded to bedrock. The bedrock is severely fractured. The spillway has eroded out of its original channel and moved closer to the dam. The right spillway is generally well vegetated with little erosion.

The erosion of the left spillway should be checked periodically. Consideration should be given to the possibility of regrading and realigning the left spillway.

BRIDGE AND PIERS

Not Applicable

INSTRUMENTATION

Name of Dam: GRAHAMS DAM

<u>VISUAL EXAMINATION</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
MONUMENTATION/SURVEYS	None available	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER		

RESERVOIR

Name of Dam: GRAHAMS DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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SLOPES	Reservoir slopes are gradual and fairly well vegetated. Small gullies are beginning to form on the slopes to the west of the reservoir.	
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SEDIMENTATION	None observed. Sedimentation should be minor because there are three smaller ponds upstream which should catch most sediment.	
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DOWNSTREAM CHANNEL

Name of Dam: GRAHAMS DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is clear. Vegetation on the overbanks consists of trees and thin brush. U.S. Route 22 crosses the stream approximately 300 ft. downstream of the dam. The stream flows under Route 22 in a 6 ft. by 6 ft. concrete box culvert with wing walls at 30° and 45°. The road embankment rises approximately ten ft. above the top of the culvert.	During Hurricane David, in September, 1979, the culvert was completely submerged, according to the owner.

SLOPES

The slope of the downstream channel is fairly steep. The channel banks appear to be stable. Vegetation in the overbanks consist of trees and thin brush.

APPROXIMATE NO. OF HOMES AND POPULATION

There are no homes or other structures between the dam and the Rivanna River, 1.5 mi. below Grahams Dam.

APPENDIX IV

GENERAL REFERENCES

GENERAL REFERENCES

1. Bureau of Reclamation, U.S. Department of the Interior, Design of Small Dams, A Water Resources Technical Publication, Revised Reprint, 1977.
2. Chow, Ven Te, Handbook of Applied Hydrology, McGraw - Hill Book Company, New York, 1964.
3. Chow, Ven Te, Open Channel Hydraulics, McGraw - Hill Book Company, New York, First Edition, 1959.
4. Commonwealth of Virginia, "Geologic Map of Virginia," Department of Conservation and Economic Development, and Division of Mineral Resources, 1963.
5. HR 33, "Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations of 6 to 48 Hours," (1956).
6. King, Horace Williams and Brater, Ernest F., Handbook of Hydraulics, Fifth Edition, McGraw - Hill Book Company, New York, 1963.
7. Soil Conservation Service, "National Engineering Handbook - Section 4, Hydrology," U.S. Department of Agriculture, 1964.
8. Soil Conservation Service, "National Engineering Handbook - Section 5, Hydraulics," U.S. Department of Agriculture.
9. U.S. Army, Hydrologic Engineering Center, "Flood Hydrograph Package (HEC-1), Dam Safety Investigations, Users Manual," Corps of Engineers, Davis, California, September 1978.
10. U.S. Army, Hydrologic Engineering Center, "HEC-2 Water Surface Profiles, Users Manual," Corps of Engineers, Davis, California, October 1973.
11. U.S. Army, "Inventory of United States Dams," Corps of Engineers, 9 September 1978.
12. U.S. Army, Office of the Chief of Engineers, "Appendix D, Recommended Guidelines for Safety Inspection of Dams," National Program of Inspection of Dams, Volume 1, Corps of Engineers, Washington, D.C., May 1975.

NAME OF DAM: GRAHAMS DAM

13. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-163 (Draft Engineering Manual), "Spillway and Freeboard Requirements for Dams, Appendix C, Hydrometeorological Criteria and Hyetograph Estimates," (August 1975).
14. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-188, "Engineering and Design, National Program of Inspection of Non-Federal Dams," Corps of Engineers, Washington, D.C., 30 December 1977.
15. U.S. Army, Office of the Chief of Engineers, Engineer Technical Letter No. ETL 1110-2-234, "Engineering and Design, National Program of Inspection of Non-Federal Dams, Review of Spillway Adequacy," Corps of Engineers, Washington, D.C., 10 May 1978.
16. U.S. Department of Commerce, "Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," Weather Bureau, Washington, D.C., May 1961.
17. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, "Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Washington, D.C., June 1978.

NAME OF DAM: GRAHAMS DAM